



**Madison-Gallatin Fisheries Annual Monitoring Report**

**2001**

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## **Abstract**

The Madison and Gallatin watersheds provide ample fishing opportunities and an abundance of high quality aquatic resources. Managing fisheries these waters provide requires consistent monitoring and assessment of long-term trends. This document summarizes survey and inventory data collected during 2001. Trend information and current status of fisheries inhabiting major waters are provided for each survey conducted. A number of challenges exist to wild trout fisheries in the area, such as whirling disease, increased angling pressure, and drought. Nonetheless, most fisheries in the area are healthy and likely to persist with continued protection of habitat and water quality and quantity.

## **Acknowledgements**

Field surveys are generally intensive activities that require hard work under sometimes-difficult conditions. The authors appreciate the assistance of the following individuals who participated in surveys: Wally McClure, Robin Gaustad, Dan Brewer, and Darin Watschke (USFS) conducted spawning surveys on the West Fork Hyalite Creek. Pat Clancey, Gary Senger, Jody Hupka, Justin Hawkaluk, Reed Simonson, and Scott Opitz (FWP) and Wally McClure (USFS) assisted in major rivers electrofishing. A number of FWP employees assisted in Hebgen Reservoir gill netting, including Wayne Black, Deanna Meredith, Bob McFarland, Harry Whitney, Dave Pac, and Justin Hawkaluk. Lynn Bacon (formerly of Wetlands West, Inc.) assisted in Nash Spring Creek surveys. Carol Endicott (Confluence Inc.) assisted in Catron Creek surveys. Dave and Laurie Schmidt of Wade Lake Resort assisted in surveys of Cliff and Wade Lake and provided moral support. Thanks to all of those who assisted us that we were unable to list. We also appreciate the support of anglers and sportsmen who fund the protection and enhancement of our natural treasures.

## **Introduction**

The Madison and Gallatin watersheds provide a diversity of fishing opportunities and an abundance of high quality aquatic resources. Approximately 40% of the total angling pressure in Montana Fish, Wildlife, and Parks (FWP) administrative Region 3 is exerted in the Madison–Gallatin district (MacFarland and Meredith 1999, 2000). Ranging from world-renowned large river trout fisheries, to over 80 alpine lakes, three reservoirs, and numerous urban ponds, this area provides substantial recreational and economic value to the residents and visitors alike.

Montana Fish, Wildlife, and Parks' Fisheries Division is funded through hunting and fishing license sales and through Federal Aid in Sport Fish Restoration Act (16 U.S.C 777-777k). Broad objectives for the work of the Fisheries Division are established in a Six-Year Operations Plan (FWP 2000a). Objectives modified from the plan are:

1. Survey and Inventory: Survey and monitor the characteristics, status, and trends of fish populations, habitats, and angler use and harvest in selected streams and lakes,
2. Technical Guidance and Information: Review projects, public and private, that have the potential to affect fisheries resources and provide technical advice to sustain and enhance fisheries resources,
3. Fish Population Management: Implement fish stocking programs in habitats that can't sustain fisheries naturally, to maintain fish populations and angler opportunities, and
4. Aquatic Education: Enhance the awareness, understanding, and support of aquatic resources by the general public to ensure that quality aquatic resources persist that encourage recruitment of young anglers and advocates.

This report summarizes survey and monitoring activities within the Madison – Gallatin District, project F-113 R1 for the period from January 1, 2001 to December 31, 2001. Data reported herein is continuation of historic monitoring and may have been recently reported by Byorth (2000a, 2000b) and Byorth and Weiss (2001). This report provides only basic trend information. Further analysis is necessary to draw conclusions beyond basic trends.

## **Description of Study Areas**

### **Gallatin River**

The Gallatin River is the easternmost of three major Missouri River headwater drainages. The East and West Gallatin rivers drain approximately 1800 miles<sup>2</sup> of the Bridger, Gallatin, and Madison mountains and the Horseshoe Hills (Figure 1) (Shields et al. 1999). The area is renowned for its wild trout fishing, providing an estimated 107,315 angler-days in 1997 and 121,146 in 1999 (McFarland and Meredith 1999, 2000).

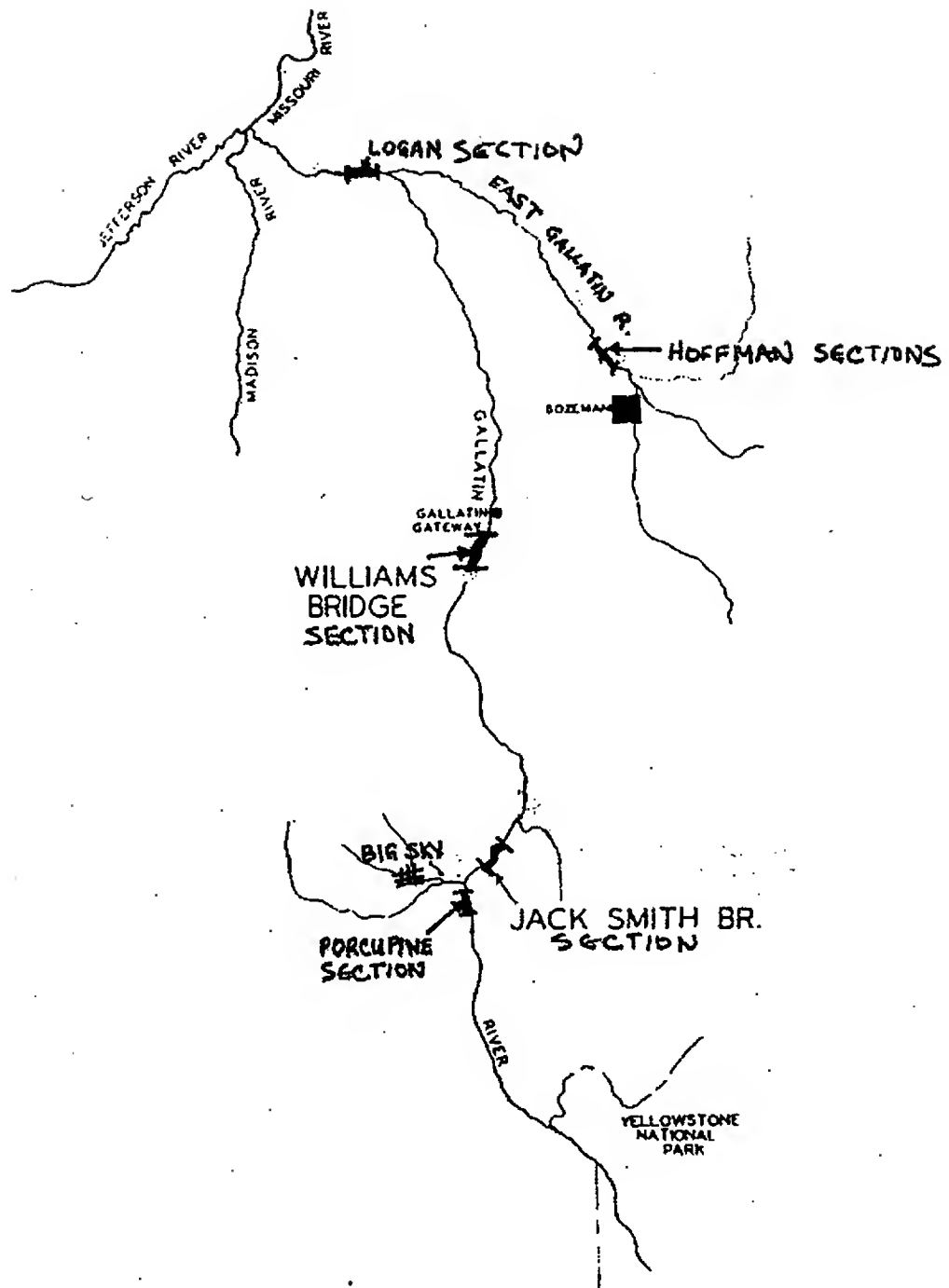


Figure 1. Map of the Gallatin Drainage, showing population monitoring study sections.

The West Gallatin River flows north through the Gallatin Canyon, which divides the Madison and Gallatin mountain ranges. The high elevation, narrow canyon maintains cool water temperatures throughout the summer with harsh conditions in the winter. The cool summer water temperatures and long winters result in slow growing trout. An average rainbow trout in the upper West Gallatin River will grow only to 12 inches after 4 to 5 years (MFWP Files). Severe winter conditions, including hazardous anchor ice, likely regulate trout abundance in the canyon. The lower 35 river miles of the West Gallatin River is more heavily influenced by irrigation diversions and channel instability. Urban and suburban development has increased attempts to stabilize the river by channelization and riprapping. In dry years, the lower West Gallatin River becomes severely dewatered by irrigation diversions (Vincent 1978).

We monitor Fall trout populations in three survey sections in the upper West Gallatin River: the Porcupine Section (2.3 miles: from Porcupine Creek to the West Fork of the West Gallatin River), Jack Smith Section (2.2 miles: Jack Smith Bridge, Highway 191 North of Big Sky) and the Williams Bridge Section (2.84 miles: Williams Bridge to 1 mile South of Gallatin Gateway) (Figure 1). Each of these sections has been electrofished intermittently since the 1980's. Detailed maps of each section are in Appendix A. The Shed's Bridge Section had been electrofished historically, but has become impassable due to recent channel changes

The East Gallatin River forms near Bozeman, Montana at the confluence of Sourdough Creek and Rocky Creek and within a few miles it joins Bridger Creek (Figure 1). The East Gallatin flows approximately 40 river miles through a heavily developed urban, suburban, and agricultural area before its confluence with the West Gallatin River. In the past, fish populations were heavily influenced by effluent from the Bozeman Municipal Sewage Treatment Plant. The primary treatment plant was replaced by a secondary treatment facility in 1971. (Vincent and Rehwinkle 1981). Improved water quality resulted in a substantial increase in wild trout abundance (Vincent 1978, Vincent 1979, Vincent and Rehwinkle 1981).

Two adjacent fall population survey sections have been sampled historically to determine the influence of the Bozeman Municipal Sewage Treatment Plant and to monitor population trends in the East Gallatin River. The Upper Hoffman section extends 0.88 miles from Springhill Road Bridge to approximately 100 yards above the sewage outfall. The Lower Hoffman Section begins at the sewage outfall and extends 1.05 miles downstream.

The East and West Gallatin rivers join approximately 12 river miles upstream of the headwaters of the Missouri River. Combined influences of irrigation withdrawals, urban development, and sedimentation appear to restrict trout populations in the mainstem Gallatin River. The Logan Section is electrofished to monitor trout populations in the mainstem. The section is 4.3 miles long extending from Nixon Bridge to near the town of Logan, Montana (Figure 1).

#### Madison River

The Madison River is arguably one of the most popular trout streams in the United States (Sample 1998, Ross 1999). The Madison River forms in Yellowstone National Park at the confluence of the Firehole and Gibbon Rivers and flows into Montana just upstream of Hebgen Reservoir (Figure 2). The

Madison River flows from Hebgen Dam through Quake Lake and 110 miles to its confluence with the Gallatin and Jefferson rivers, at the headwaters of the Missouri River. The Madison's legendary trout fishery arose out of a long history, beginning in 1919 with the arrival of rainbow and brown trout introduced in Yellowstone Park (Vincent 1962). Fisheries management historically meant stocking catchable-sized trout in reaches of the Madison River until 1969, when "wild trout management" was initiated (Vincent et al. 1990). All stocking was eliminated from the Madison River by 1973 based on research demonstrating that wild trout stocks were hindered by stocking trout (Vincent 1987).

Five study sections characterize the Madison River trout populations (Figure 2). Detailed maps of each section are in Appendix A. The Pine Butte section lies approximately 12.0 miles below Quake Lake, extending from Pine Butte Creek to Lyons Bridge (3.0 miles). The Madison River through this reach has fairly uniform gradient, with a network of side channels that influence spawning and recruitment. The West Fork Madison River enters the Pine Butte Section approximately 0.6 miles above Lyons Bridge. Fishing regulations on this reach have been catch-and-release only for trout since 1978 and no fishing from boats has been allowed since 1974. Since 1995, the fishing season has been from open the third Saturday in May through the end of February to protect spawning rainbow trout. Population estimates have been conducted on the Pine Butte Section since 1977.

The Snoball Section lies between Squaw Creek and Windy Point. From 1975 to 1994, the section was 4.5 miles long. The section was shortened to 4.0 miles in 1994. The Madison River in this reach has few large tributaries and fewer side channels than the Pine Butte section. The Snoball section has been used to study the impacts of angling, regulations, and disease since 1977 when it was closed to all fishing. It was opened to catch-and-release fishing for trout and fishing from boats in March 1983 (M. Lere pers. comm. and MFWP Files). To further study the impacts of angling and whirling disease, it was closed to fishing again between March 1995 and February 1997.

The Madison River changes character considerably in the Varney Section, approximately 40 miles downstream from Quake Lake. This section extends from Varney Bridge to Eight Mile Ford Fishing Access Site, a length of 4.0 miles. Brown trout predominate in the complex and heterogeneous habitats that a braided channel provides. Habitat in the Varney section is highly influenced by ice gorging (Vincent 1990). Annual fall population surveys have been conducted in the Varney Section since 1967. Fishing regulations allow harvest of 5 brown trout, only one over 18 inches long, catch-and-release only for rainbow trout, in effect since 1992.

Ennis Reservoir influences the Madison River significantly. After flowing 8 river miles through Beartrap Canyon, the gradient flattens and it takes on characters of a spring creek: broad and shallow with extensive weed beds and extensive fine sediment. Water temperature is the primary limiting factor in this reach. Ennis reservoir acts as a heat sink, increasing water temperatures in the Madison River to near lethal levels in mid-summer, causing fish kills in dry, and hot years (Vincent et al. 1981). The Norris section characterizes trout populations in this reach, extending 4.0 miles from the mouth of Warm Springs Creek to the mouth of Cherry Creek. This reach is open to fishing year-round with a combined trout limit of 5 fish,

only 1 over 18 inches long. Population estimates have been conducted in spring annually in the Norris Section since 1970.

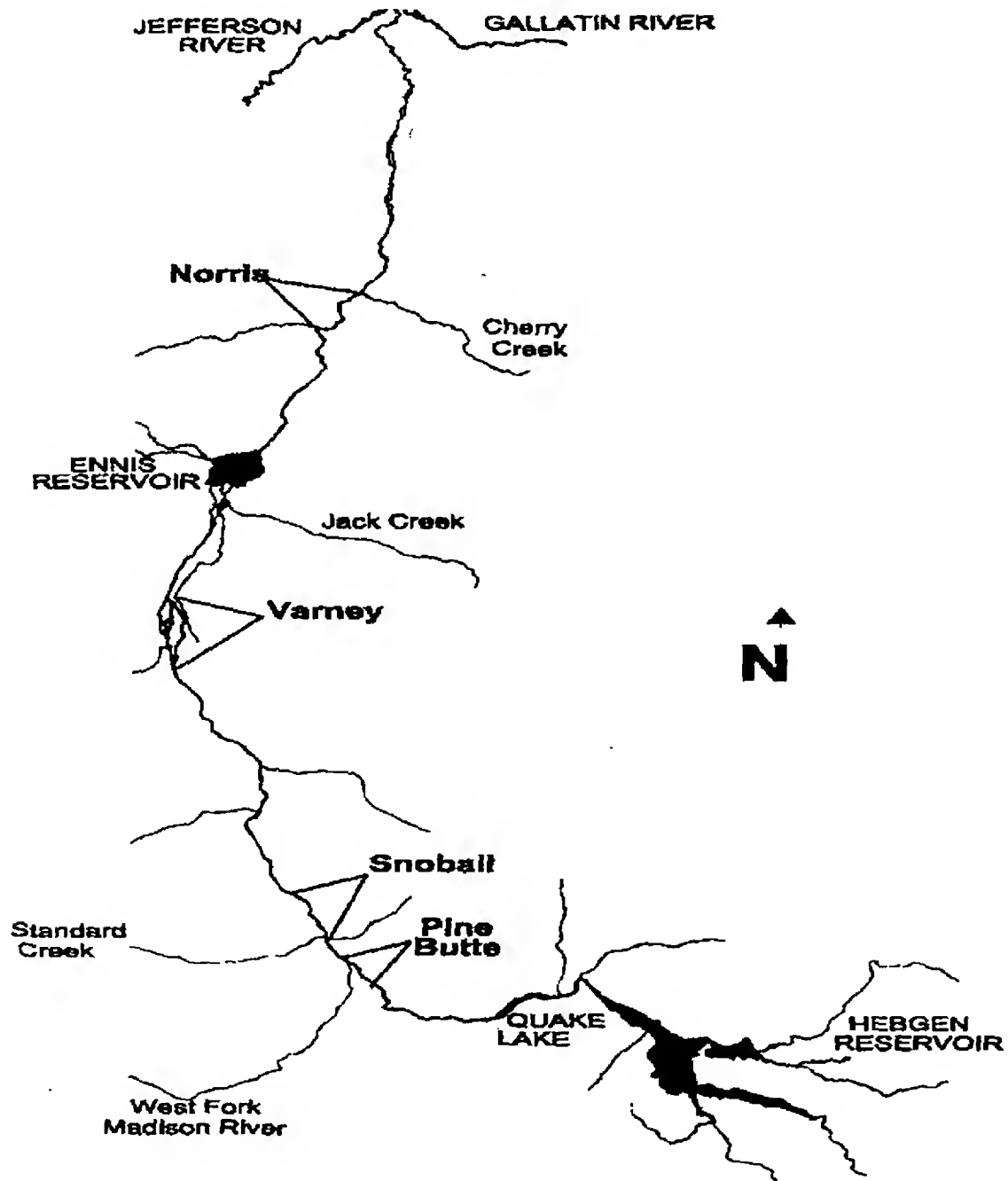


Figure 2. Map of Madison River drainage with population survey study sections.

### Hebgen Lake

Hebgen Lake is storage impoundment on the Madison River, located four miles north of West Yellowstone, MT. Hebgen Dam is owned and operated by PPL Montana under FERC License 2188 to regulate flows to the hydroelectric plant at Madison Dam near Ennis. The reservoir first filled in 1915 after construction of Hebgen Dam. At full pool elevation of 6534 feet above mean sea level (amsl), the reservoir's surface area is 12668 acres. The reservoir fishery is supported by wild, self-sustaining brown trout and rainbow trout. The primary management goal at Hebgen Lake is to establish a self-sustaining rainbow trout population. Currently, wild reproduction is supplemented with annual plants of 100,000 eagle lake rainbow trout fry, a wild strain. During 1980-1988, McBride strain Yellowstone cutthroat trout were planted in Hebgen Lake. Their inability to naturally reproduce led to the cessation of the stocking program (Hetrick 1994). Mountain whitefish, native to the Madison Drainage, also complement the fishery. Utah chubs occupy a large proportion of fish biomass in Hebgen Lake. They were likely introduced, probably by anglers as a baitfish, around 1935 (Leik 1978).

### Cliff and Wade Lakes

Cliff Lake is located approximately 45 miles south of Ennis, MT. It is a 620 acre natural lake at an elevation of 6313 amsl. Rainbow trout have historically dominated this fishery. Natural reproduction (Cliff Lake has at least three tributaries capable of supporting spawning) was occasionally supplemented with plants of hatchery stock. Until the 1950's, fishing was reportedly good for rainbow trout. Cliff Lake's fishery has struggled in the last 40 years. A 1961 graduate project found the lake's rainbow trout population to be heavily parasitized (Fox 1961). This, accompanied by disease and overpopulation, was suspected as a reason for the fishery's decline. The last rainbow trout plant was in 1969. Surveys in the 1970's and 1980's indicated a rebound in the lake's rainbow trout population. Bonneville cutthroat trout were stocked experimentally in 1990 to see if the Bonneville strain would utilize the abundant forage base in Cliff Lake consisting of lake chub and white sucker. Subsequent sampling in the 1990's suggested the plant failed to produce a viable reproducing population. During the mid 1990's, Rainbow trout numbers began a downward trend and their physical condition deteriorated.

Wade Lake is located one mile north of Cliff Lake. It is a 240 acre natural lake at an elevation of 6217 amsl. The present state record brown trout was caught in Wade Lake, which still produces trophy-sized specimens. Rainbow trout were stocked on a regular basis, as the single small spring flowing into the lake supported little spawning. In 1991, FWP, the U.S. Forest Service, and Interfluve Inc. (a Bozeman, MT- based natural resource reclamation firm) constructed a 600 ft. spawning channel at the head of Wade Lake (Brooks 1992). Stocking ceased in 1991 and the spawning channel now provides adequate spawning habitat to sustain rainbow and brown trout populations. White suckers are also present. Wade Lake is sampled periodically to ensure trout populations are stable.



### Hyalite Reservoir

Hyalite Reservoir is an irrigation storage impoundment on Hyalite (Middle) Creek, filled in 1951 with the completion of the Hyalite (Middle) Creek Dam. In 1993, dam reconstruction raised full pool elevation 8.2 vertical feet to 6715 amsl with surface area of approximately 260 acres. Summer and fall irrigation in the Gallatin Valley and municipal diversions cause extreme fluctuations in pool elevation.

Westslope cutthroat trout (Oncorhynchus clarki lewisi) were the native trout species in the drainage, but are currently restricted to a tributary of Middle Creek below the dam (FWP 2000b). Eastern brook trout (Salvelinus fontinalis) and rainbow trout (O. mykiss) were introduced in the Hyalite basin, as well as Yellowstone cutthroat trout (O. clarki clarki) (YCT). Wells (1976) reported rainbow-cutthroat trout hybrids in the reservoir. Brook trout still inhabit the reservoir, with YCT, which likely “genetically swamped” rainbow trout from above the dam. Montana Department of Fish and Game began planting YCT in 1953. Approximately 30,000 YCT fry are planted annually. Whereas Wells (1976) documented YCT spawning in the tributaries of the reservoir, he did not detect recruitment of cutthroat fry. Zubick (1983) documented successful spawning and recruitment of YCT and recommended cessation of stocking.

Arctic grayling (Thymallus arcticus) are native to the Hyalite basin, although they were probably planted during the same time period as cutthroat trout. No records of grayling plants in the drainage exist in MFWP stocking databases. However, Emerald Lake, at the headwaters of the East Fork of Hyalite Creek, supports an Arctic grayling population. While no records exist, Emerald Lake was certainly stocked and is the probable original source of grayling to the reservoir. The current sport fishery is comprised mainly of YCT, Arctic grayling, and brook trout. A former state record Arctic grayling was caught in Hyalite Reservoir. The dam reconstruction and increased pool elevation flooded 80 to 90% of historical grayling spawning grounds in the West Fork of Hyalite Creek. The Montana Department of Natural Resources and Conservation (DNRC) constructed a new side channel to attempt to mitigate effects of lost spawning habitat.

Recent management efforts focused on maintaining satisfactory angler catch rates of YCT by supplementing the naturally reproducing population with McBride strain hatchery YCT. In addition, we are monitoring success of mitigation at protecting the grayling population in conjunction with the Gallatin National Forest. Byorth and Weiss (2001) summarized fisheries surveys and impacts of raising reservoir pool elevation.

### Miscellaneous Surveys

In addition to routine surveys and censuses, certain water bodies are sampled occasionally to address management questions. During 2001, Nash Spring Creek and East Catron Creek were electrofished to determine the impacts of stream relocation on trout populations. Both streams were historically channelized to drain wetlands or to maximize tillable acres for agricultural production. Over the last three years, these lands have been developed for commercial and residential properties. Developers applied for appropriate permits and were allowed to relocate the streams with specific requirements to improve fish habitat. Nash Spring Creek is a tributary of Sourdough (a.k.a. Bozeman) Creek.

Approximately, 1,650 feet of Nash Spring Creek was realigned in Summer of 2000, to accommodate home construction and route the stream through a city park. To assess impacts on fish densities, we electrofished two 500 ft. long sections. One section was in the relocated reach, beginning just below Goldenstein Lane, and the other was in an undisturbed reach extending 500 feet upstream from a fence crossing along the Sourdough Spur trail.

East Catron Creek is a tributary of the East Gallatin River that has been realigned a number of times. Approximately 1,200 feet was realigned to accommodate the building of a motel in the early 1990's. Another reach was realigned in 1999 to accommodate additional commercial construction, with additional projects currently in the permitting process to realign another 2,500 in separate reaches. The goal of permitting is to improve fish habitat markedly as the area is developed. We electrofished four 500 foot reaches, in various states before and after relocation.

Camp Creek is a tributary of the Gallatin River heavily impacted historically by agriculture and road and railroad alignment. Much of the Camp Creek basin is comprised of deep soils, an abundant source of fine sediment. State Highway 84 crosses Camp Creek approximately 14 miles west of Bozeman, MT. Much of Highway 84 is scheduled for major reconstruction, including the culvert through which Camp Creek passes. We backpack electrofished a 500 foot section above the culvert to calculate a two-pass population estimate. We electrofished below the culvert for 20 min to assess whether the culvert may be a fish passage barrier and characterize the population.

Mountain lake surveys were conducted on Bear lakes in the Bear Creek drainage (T3SR7E Sec. 28) east of Bozeman, MT and Big Bear Lake, in the Big Bear Creek drainage west of Bozeman (T4SR5Esec 15). Lakes were visited and sampled with hook and line and/or gill nets. Potential spawning areas were assessed for evidence of natural reproduction. No fish were caught in gillnets, nor observed in Big Bear Lake. The inlet was heavily silted and filled with woody debris. Yellowstone cutthroat trout will be stocked in Big Bear Lake in 2002.

Lower Bear Lake was covered with aquatic vegetation, and is unlikely to support fish through the winter. Upper Bear Lake supports a self-sustaining population of rainbow-cutthroat hybrids. Rainbow trout were present and self-sustaining by 1958 (FWP Files). We caught 5 fish 7.0 to 13.5 inches long by hook and line. We also observed a number of fish 7 – 14 inches in approximate length. Both inlet and outlet are likely to support spawning, and 2 apparent redds were seen in the inlet. The lake should be managed to remain self-sustaining. However, both lakes were used extensively for fire fighting during 2001 and the population may have suffered from dewatering.

### Methods

Electrofishing is used to conduct Mark-Recapture experiments to estimate trout populations. A drift boat-mounted, mobile positive electrode system is used to capture trout on large rivers such as the Madison, Gallatin, and East Gallatin rivers. The drift boat system is equipped with 4,500 Watt generator and Coffelt Mark XXII-M rectifying Unit. During electrofishing runs, trout are netted, held in a live well,

anesthetized in an MS-222 bath, measured to 0.1 inches in total length, weighed to 0.01 lbs, marked with a fin clip, and released after recovering. Multiple marking runs are followed by recapture runs after 10 to 14 days. The number of electrofishing passes is determined by the sample sizes required to construct statistically valid population estimates (generally more than 10% of the population). The ratio of marked to unmarked fish in the recovery sample is used to estimate abundance according to FWP's computerized Mark Recapture Log-likelihood model. On smaller streams, we use a backpack mounted electroshocker to capture trout and generally use similar fish handling methods and calculate depletion estimates. Scale samples are collected for age determination and to determine age class abundance. Detailed maps of study sections are in Appendix A.

We use gill nets to sample Hebgen Lake and Cliff and Wade lakes. We set experimental gill nets 125 feet long by 6 feet deep with a bar mesh range from 1 to 3 inches. At Hebgen Reservoir, annual sampling occurs during the last week of May or the first week of June. A combination of 24 to 27 bottom and surface nets were set over a three night period. Nets are set at consistent locations each year, although low reservoir levels dictated the omission of certain sets in some years (Appendix A). Gill nets are set intermittently at Wade and Cliff lakes, generally during October. Four surface nets and one bottom net were set in Cliff Lake. Three surface nets and one bottom net were set in Wade Lake (Appendix A). On each lake or reservoir, gill nets are set during late afternoon and retrieved the following morning. Fish found alive are processed and released. All fish caught in nets are identified to species, measured to nearest 0.1", weighed to nearest 0.01 lb., and examined for marks, hook scars, and sexual condition. Scale samples are taken from trout for age analysis. On Hebgen Reservoir, rainbow trout were examined for external hatchery characteristics and we extracted vertebrae from deceased specimens to examine for tetracycline marks. A microscope and a blacklight were used to examine vertebrae for tetracycline marks.

Hyalite Reservoir salmonids are monitored annually through spawning surveys. Yellowstone cutthroat trout and Arctic grayling both spawn in the West and East Forks of Hyalite Creek. Spawner counts are conducted May – July annually, from reservoir pool elevation to Window Rock Bridge in the West Fork. Surveyors walk upstream, counting adult fish of both species, generally 2 days per week for the duration of spawning (generally mid-May to mid-July).

## **Results**

### **West Gallatin River**

Trout populations are stable in reaches of the West Gallatin where monitoring is conducted. In the Gallatin Canyon (Porcupine and Jack Smith sections) rainbow trout predominate. Brown trout are found in very low numbers. For example: brown trout abundance in the Porcupine Section was estimated to be 66 per mile in 1998 and 118 per mile in 2000. All brown trout were age 3 and older. Apparently, brown trout recruitment is virtually non-existent in the canyon. Brown trout in these reaches are likely migrants.

Rainbow trout populations in the canyon were at or near the upper end of the recorded range of abundances. Long-term trends in both Porcupine and Jack Smith sections are stable at relatively high levels after an apparent decline in the mid 1990's in both sections.

In the Porcupine Section, numbers of rainbow trout 8 inches and longer decreased slightly from 1998 to 2000 (Table 1), but all mature size classes remained near recorded highs. Strength of rainbow trout populations is likely due to consistent survival through a series of mild winters. For example, the 1995 year class (age 1 in 1996, Table 2) decreased from 510 as age 1, to 418 as age 3, to 357 as age 5. This moderate mortality rate reflects the tendency of rainbow trout recruitment in the upper Gallatin River to fluctuate based on spring runoff and winter mortality, especially of juveniles. The stock of mature fish (age 3+) available for spawning has remained stable in the Porcupine Section, an indication that angling mortality is unlikely to be a limiting factor (Table 2). Table 3 demonstrates the slow growth rates of rainbow trout in the Gallatin Canyon, reaching only an average of 9.0 inches as age 3, the likely age of sexual maturity.

Table 1. Rainbow trout population summary for trout longer than 8.0 inches (generally Age 3 and older) in the Porcupine Section of the West Gallatin River, Fall 1984 – 2000. Values are number per river mile by length category.

Year	Number > 8 inches	Number > 10 inches	Number > 13 inches
1984	915	329	29
1987	1250	412	25
1995	819	386	100
1996	558	333	87
1998	1355	702	162
2000	1221	629	143

Table 2. Rainbow trout population estimates by age class in the Porcupine section of the West Gallatin River, fall 1996, 1998, and 2000. Values are number per river mile. Standard deviations (SD) are provided for total population estimates.

Year	Estimated Number By Age Class (number per mile)					Total (SD)
	Age 1	Age 2	Age 3	Age 4	Age 5	
1996	510	362	264	111	207	1454 (47)
1998	384	383	418	406	566	2157 (245)
2000	278	447	515	303	357	1900 (210)

Rainbow trout populations in the Jack Smith section are similar to the Porcupine section, displaying a peak in density in the late 1980's with a decline in the mid 1990's and a more recent increase. However, more recent surveys have not detected a return of rainbow trout densities equivalent to recorded levels, except for the 2000 surveys (Table 4). Population estimates derived in 2000 show a significant

increase, doubling previous recorded highs. This is likely an artifact of drought conditions and cold weather when electrofishing occurred. Typical winter habitat (e.g. deeper pools) in the Jack Smith section may have attracted artificially high numbers of rainbow trout to the Jack Smith Section during Fall 2000. However, the rainbow trout estimates by age class (Table 5) indicate age 3 and older populations are near long term averages. Poor recruitment of the 1993 age class (age 2 in 1995, Table 5) is reflected in the low estimate of age 5 rainbow trout in 1998. Recent estimates of age 2 rainbow trout indicate relatively strong age classes in 1996 and 1998, although these estimates are not based on actual scale readings, but on long-term length-at-age ratios.

Table 3. Mean length-at-age of rainbow trout in the Porcupine Section of the West Gallatin River, Fall 1996, 1998, and 2000.

Year	Mean Length by Age Class (inches)				
	Age 1	Age 2	Age 3	Age 4	Age 5
1996	4.8	6.9	8.8	10.5	12.5
1998	5.4	7.3	8.9	10.1	11.5
2000	5.2	7.0	9.2	10.5	12.7
3 year Mean	5.1	7.1	9.0	10.4	12.2

Table 4. Estimated population of rainbow trout in the Jack Smith section of the Gallatin River obtained during the late summer or early fall of 1981-1984, 1989, 1995-1996, 1998, and 2000. Estimates are presented as number per river mile.

Year	Number > 8 inches	Number > 10 inches	Number > 13 inches
1981	2819	1169	167
1982	2308	910	99
1983	2596	1217	108
1984	2490	1149	123
1989	3449	1413	131
1995	1460	896	181
1996	1505	936	237
1998	1464	749	167
2000	4946	2381	402

In the Williams Bridge Section, estimated rainbow and brown trout populations are at or near recorded highs in each size group (Table 6). Estimated populations by age class reflect a healthy age distribution of rainbow trout in the Williams Bridge section, characteristic of a stable population with good recruitment (Table 7). The age composition of the brown trout population indicates inconsistent recruitment with an abundance of older, larger fish. Trout grow at slightly faster rates than in upstream reaches, but they still reflect some growth limitation likely due to cool water temperatures.

Table 5. Estimated rainbow trout abundance in the Jack Smith Section of the West Gallatin River by age class, fall 1981 – 2000. Abundance estimates are in number per river mile. The estimates for 1996–2000 are based on previously documented length-at-age ratios and should be considered preliminary. The others are based on actual scale samples and standard deviations (SD) are provided for total population estimates.

Year	Age 2	Age 3	Age 4	Age 5	Total (SD)
1981	2034	973	353	182	3542 (574)
1982	1951	1017	279	80	3327 (211)
1983	1784	1300	431	123	3640 (217)
1984	936	1324	614	387	3262 (198)
1989	2231	1453	763	270	4718 (321)
1995	437	380	350	855	2022 (229)
1996	1226	457	502	237	2422
1998	1037	506	360	184	2087
2000	3255	2100	1125	402	6882

Table 6. Summary of Fall population estimates on rainbow and brown trout in the Williams Bridge Section of the West Gallatin River, 1977, 1990, 1997, 1999, and 2001. Estimates are in number per river mile.

Year	Rainbow Trout			Brown Trout		
	>8.0"	>10.0"	>13.0"	>8.0"	>10.0"	>13.0"
1977	673	443	146	604	483	338
1990	1316	638	131	484	435	330
1997	1125	585	218	609	510	261
1999	1224	568	198	562	505	360
2001	1424	696	212	795	671	468

Table 7. Mean length-at-age and estimated population (number per mile) of rainbow and brown trout in the Williams Bridge Section of the West Gallatin River, Fall 2001.

Species	Mean Length by Age Class (inches)				
	Age 1	Age 2	Age 3	Age 4	Age 5+
Rainbow trout	5.4	7.4	9.2	10.8	13.4
Brown trout	6.5	7.5	9.3	10.5	14.5
Species	Population Estimate (number per mile (SD))				
	Age 1	Age 2	Age 3	Age 4	Age 5+
Rainbow trout	724 (131)	566 (123)	394 (103)	440 (80)	229 (74)
Brown trout	138 (56)	79 (48)	142 (52)	18 (48)	366 (172)

#### East Gallatin River

The East Gallatin River is warmer and more productive than the West Gallatin River as reflected in trout growth rates (Table 8). However, rainbow trout growth rates may be somewhat limited by their abundance (Table 9). For a stream of its size (less than 50 feet average width) the East Gallatin River supports a substantial trout fishery, numerically dominated by rainbow trout. Population estimates of age 1 and older rainbow and brown trout indicate a peak in density during 1998 – 2000 (Table 9). However, the impacts of the ongoing drought are reflected in a decreased abundance across both Hoffman sections and both species in 2001. Persistent drought may be affecting the population through poorer habitat quality, less available habitat volume, increased susceptibility to predation and angling, and higher winter mortality. However, populations of both rainbow and brown trout in the Hoffman sections are within long term ranges of variability and can be expected to recover as drought conditions improve.

Table 8. Length-at-age (inches) estimates for rainbow and brown trout in the Hoffman sections of the East Gallatin River based on scale samples 1985 – 1987.

Species	Age 1	Age 2	Age 3	Age 4	Age 5	Age 6
Rainbow Trout	7.3	9.3	10.7	11.9	13.2	13.7
Brown Trout	8.1	10.5	12.6	14.0	15.0	16.0

#### Gallatin River

The Gallatin River below the confluence of its forks suffers a variety of cumulative impacts including sedimentation, warm water temperatures, dewatering, and presence of *M. cerebralis*, the causative agent of whirling disease. Thus, trout populations are much lower than other area rivers. In 1999, we revived the Logan section for long-term monitoring, but the short span of data makes interpretation of trends difficult. Estimated rainbow trout populations were higher in 2001 than in previous surveys, while brown trout populations decreased somewhat (Table 10). Note very few juvenile rainbow or brown trout (less than 10 inches long) are present, indicating recruitment limitation.

Table 9. Rainbow and brown trout population summary (age 1+) for the upper and lower Hoffman sections of the East Gallatin River, 1994 - 2000. Population estimates are listed as number per mile by length group.

Upper Hoffman Section (1.2 miles)						
Year (Fall)	rainbow trout per mile			Brown trout per mile		
	≥ 6.0 inches	≥ 10.0 inches	≥ 13.0 inches	≥ 6.0 inches	≥ 10.0 inches	≥ 13.0 inches
1994	2550	600	110	847	645	271
1995	2157	450	141	1103	669	453
1996	2397	628	68	384	310	229
1997	1701	697	125	290	155	99
1998	3108	668	152	522	266	137
1999	4877	1712	213	663	427	208
2000	3408	1083	188	1053	724	358
2001	1649	648	80	748	458	262
Lower Hoffman Section (0.88 miles)						
Year (Fall)	≥ 6.0 inches	≥ 10.0 inches	≥ 13.0 inches	≥ 6.0 inches	≥ 10.0 inches	≥ 13.0 inches
1994	2089	748	219	556	397	226
1995	3498	1108	320	501	363	225
1996	2557	1234	277	646	550	464
1997	1915	982	405	359	316	149
1998	3376	1237	329	647	355	283
1999	4801	2288	653	757	539	198
2000	4633	3164	647	765	408	205
2001	2326	1700	739	526	319	138



Table 10. Rainbow and brown trout population estimates (number per mile) in the Logan Section (4.3 miles below Nixon Bridge) of the Gallatin, Montana, Spring 1999-2001.

	Brown Trout			Rainbow Trout		
Year	>6.0 inches	>10.0 inches	>13.0 inches	>6.0 inches	>10.0 inches	>13.0 inches
1999	473	390	208	353	270	107
2000	350	307	128	321	281	103
2001	304	274	184	487	454	344

#### Madison River

Trout populations in the Madison River above Ennis Reservoir have been affected by a variety of influences over the years. Byorth (2000a) summarized the influence of regulations and whirling disease on populations through 1998. Whirling disease has been the primary factor limiting rainbow trout populations in the upper Madison since 1991 (Vincent 1996). In each monitoring section above Ennis Reservoir, trout populations increased in 1999 and 2000 and decreased slightly into 2001 at healthy levels.

In the Pine Butte section, rainbow trout populations experienced an increase in numbers of age 1 fish. The 1998 year class of rainbow trout survived well into larger size classes. Similarly, the 1999 year class was substantial, but survival to maturity was less than the previous cohort. As these age classes matured, angling improved markedly according to anecdotal reports. Age 1+ rainbow trout populations were near long-term averages in 1999 and 2000, but decreased in 2001. Drought conditions may have impacted reproduction and survival by increasing susceptibility to whirling disease as well as lower stream flows diminishing winter habitat quality. Potential flow related limiting factors are further evident in brown trout population estimates (Table 11). After reaching long-term record abundance in 1999, Age 1+ populations remained strong until 2001. Lower flows throughout 2001 may have impacted brown trout populations, but estimated brown trout abundance was near long-term averages in 2001.

Trout populations in the Snoball section exhibited a pattern similar to that of the Pine Butte section, but did not decline in 2001. Good recruitment was evident for the 1998 cohort in the 1999 fall rainbow trout population estimates (Table 12). While populations never regained abundances documented before whirling disease, rainbow trout numbers markedly increased over 1994 – 1997 levels (Byorth 2000a). Unlike the Pine Butte rainbow trout population, a slight increase in abundance was evident in Fall 2001 in the Snoball section, although estimates are preliminary. Estimated brown trout abundances in the 1999 and 2001 fall surveys were the second and third highest estimates on record, respectively (Table 12).

Table 11. Rainbow and brown trout population estimates in (number per mile) the Pine Butte Section (3.0 Miles above Lyons Bridge) of the Madison River, Montana, Fall 1994-2001. Standard deviations (SD) are listed for finalized estimates.

Year	Rainbow Trout		
	Age 1 Per Mile	Age 2 and older Per Mile	Total Age 1 and older Per Mile (SD)
1994	94	236	330 (20.5)
1995	510	175	685 (65.8)
1996	735	447	1182 (88.9)
1997	454	267	809 (73.3)
1998	847	305	1152 (85.9)
1999	2729	656	3385 (465.6)
2000*	2100	1659	3759
2001*	1794	702	2496

Year	Brown Trout		
	Age 1 Per Mile	Age 2 and older Per Mile	Total Age 1 and older Per Mile (SD)
1994	282	919	1201 (157.7)
1995	620	509	1129 (70.7)
1996	1158	446	1604 (84.2)
1997	831	929	1760 (154)
1998	1018	794	1812 (103.4)
1999	1419	1373	2792 (497.7)
2000 *	962	1171	2133
2001*	728	1024	1752

\*2001 Preliminary, based on historic age data, subject to change with actual scale data.

Table 12. Rainbow and brown trout population estimates (number per mile) in the Snoball Section (below Squaw Creek to Windy Point, 4.0 miles) of the Madison River, Montana, Fall 1994-2001. Standard deviations (SD) are listed for finalized estimates.

Year	Rainbow Trout		
	Age 1 Per Mile	Age 2 and older Per Mile	Total Age 1 and older Per Mile (SD)
1994	232	289	521 (68.0)
1995	384	208	592 (45.7)
1996	348	406	754 (78.3)
1997	227	190	417 (70.2)
1999	1050	374	1424 (88.8)
2001*	1353	510	1863

Year	Brown Trout		
	Age 1 Per Mile	Age 2 and older Per Mile	Total Age 1 and older Per Mile (SD)
1994	360	559	919 (51.8)
1995	566	612	1178 (65.7)
1996	855	1182	2037 (233.2)
1997	633	604	1237 (141.3)
1999	874	954	1828 (70.5)
2001*	779	1018	1797

\*2001 Preliminary, based on historic age data, subject to change with actual scale data.

Brown trout are predominant in the Varney section. Estimated fall populations of age 1 and older brown trout peaked in 1998, remained strong through 2000, and declined into 2001 (Table 13). In 2001, abundance of brown trout decreased across age groups, in spite of apparently good recruitment of the 1999 year class. Decreased survival of all age classes likely reflects flow limitations during the summer of 2001. However, combined age 1 and older estimated brown trout abundance was near long-term average levels.

Rainbow trout significantly decreased in abundance in the Varney section in the mid-1990's (Byorth 2000a). As in upstream reaches, estimated fall rainbow trout abundance increased with good recruitment from the 1998 and 1999 year classes. A downward trend in rainbow trout abundance is apparent in 2001, but 2000 was apparently a moderately successful spawning year and should maintain near average numbers into 2002.

Table 13. Rainbow and brown trout population estimates (number per mile) in the Varney Section (Varney Bridge to Eight-mile Ford, 4.0 miles) of the Madison River, Montana, Fall 1994-2001. Standard deviations (SD) are listed for finalized estimates.

Year	Rainbow Trout		
	Age 1 Per Mile	Age 2 and older Per Mile	Total Age 1 and older Per Mile (SD)
1994	33	166	199 (27.6)
1995	351	132	483 (70.4)
1996	145	304	449 (54.9)
1997	106	113	282 (28.3)
1998	192	139	331 (36.2)
1999	740	236	976 (190.4)
2000*	1366	409	1775
2001*	714	281	995

Year	Brown Trout		
	Age 1 Per Mile	Age 2 and older Per Mile	Total Age 1 and older Per Mile (SD)
1994	1278	631	1909 (75.1)
1995	770	704	1474 (76.3)
1996	1558	515	2073 (84.4)
1997	1122	949	2071 (123.5)
1998	2180	1061	3241 (132.8)
1999	1674	1244	2918 (194.0)
2000*	1706	1076	2782
2001*	1133	850	1983

\*2000-01 Preliminary, based on historic age data, subject to change with actual scale data.

The trout fishery of the Madison River changes substantially below Ennis Reservoir. Rainbow and brown trout tend to be nearly equivalent in abundance. Impacts of whirling disease are apparently suppressed by thermal limitations, but warm mid-summer water temperatures can approach lethal levels. Rainbow trout abundance improved in the Norris Section continuing a recovery from low levels in the mid-1990's to above average abundance in 2001 (Table 14). Brown trout have also fared well in the Norris

section from 1998 to 2001 reaching long-term average levels. However, persistent drought conditions are likely to affect survival of older age classes in the near future.

Table 14. Rainbow and brown trout population estimates (number per mile) in the Norris Section (Warm Springs Creek to Cherry Creek, 4.0 miles) of the Madison River, Montana, Spring 1994-2001. Standard deviations (SD) are listed for finalized estimates.

Year	Rainbow Trout		Total Age 2 and older Per Mile
	Age 2 Per Mile	Age 3 and older Per Mile	
1995	273	531	804 (55.7)
1996	184	535	719 (62.5)
1997	552	220	772 (38.7)
1998	555	736	1291 (104.5)
1999	820	772	1592 (266.9)
2000	330	937	1267 (76.6)
2001*	643	1422	2065

Year	Brown Trout		Total Age 2 and older Per Mile (SD)
	Age 2 Per Mile	Age 3 and older Per Mile	
1995	435	706	1141 (254.2)
1996	696	510	1206 (64.0)
1997	294	613	882 (63.0)
1998	601	507	1108 (66.1)
1999	980	1017	1997 (356.0)
2000	968	686	1654 (93.1)
2001 *	1085	1154	2239

\*2001 Preliminary, based on historic age data, subject to change with actual scale data.

#### Hebgen Reservoir

Annual spring gill net series are used to gather trend information as an index of relative abundance of game and non-game species. While wild reproduction predominates for all species, rainbow trout are also stocked annually. Rainbow trout catches in floating nets (the best indicator for rainbow trout abundance) declined in catch-per-net from 1995, the highest catch rate on record for spring floating nets (Table 15). Long term average catch per net between 1973 and 2001 was 5.4 (SD 3.43) rainbow trout per net in spring floating nets. Prior to 1986, the onset of stocking wild strains of rainbow trout, net catches averaged 2.42 (SD 1.02) rainbow per floating net. Since 1986, spring catch rates of rainbow trout have averaged 6.76 (SD 3.28). Catch-per-net of rainbow trout rose to above average levels in 1998 and 1999, but fell to post-1986 record lows in 2001. Potential limiting factors may include poor natural reproduction due to drought conditions, poor planting success in 2000 (extensive mortality was reported by hatchery personnel), or simply sampling error. However, a creel census conducted June 2000 to May 2001 indicated catch rates of rainbow trout ranging from 0.19 to 0.62 per hour (FWP Files).

The contribution of stocked rainbow trout to the Hebgen Reservoir fishery is under investigation. Recently collected information based on observed dorsal fin erosion versus tetracycline marks (tetmarks) as indicators of hatchery origin is summarized in Table 16. Not all fish exposed to tetracycline display a

vertebral mark (Jack Boyce, FWP Pers. Comm.), nor do all hatchery-reared fish exhibit fin erosion. We detected tetmarks on 0 to 6% of rainbow trout caught in gill nets (Table 16). In comparison, we detected dorsal fin erosion on 3.9 to 22.5% of rainbow trout caught in gill nets during the same years. Thus, a conservative estimate of hatchery rainbow trout contribution to the fishery is less than 25%. We will continue researching hatchery contribution to the Hebgen rainbow trout population.

Brown trout catches in sinking nets (the best index for brown trout abundance) averaged 10.94 (SD 3.44) since 1971. In recent years, spring brown trout catches in sinking nets have been near long-term average. However, spring catches were below average through much of the early 1990's (Table 15). Mountain whitefish catch rates have been relatively stable since 1994 (Table 15). Utah chub catches have fluctuated widely since 1994, currently decreasing from high levels recorded in 1999.

Table 15. Summary of rainbow trout (RB), brown trout (LL), mountain whitefish (MWF), and Utah chub (UC) catch-per-net in Spring gill net series on Hebgen Reservoir, 1995 to 2001.

Floating Nets					
YEAR	NO. OF NETS	RB/NET	LL/NET	MWF/NET	UC/NET
1995	12	15.3	8.4	1.1	18.9
1996	14	5.9	4.3	0.7	54.6
1997	14	5.6	3.9	0.1	89.2
1998	14	9.4	2.6	1.1	41.1
1999	13	7.2	13.3	1.5	143.2
2000	14	6.0	3.7	0.2	96.0
2001	14	2.5	2.4	0.29	62.5
Sinking Nets					
YEAR	NO. OF NETS	RB/NET	LL/NET	MWF/NET	UC/NET
1995	12	0.8	7.1	18.5	13.4
1996	13	0.9	7.5	16.8	55.5
1997	11	0.8	8.5	16.3	24.5
1998	10	1.1	6.5	12.0	60.2
1999	11	0.8	11.7	19.4	26.6
2000	11	0.7	9.5	11.7	33.3
2001	11	0.5	11.1	18.1	69.2

Table 16. Summary of contribution of wild and hatchery-reared rainbow trout to gill net catches in Hebgen Reservoir, 1996 – 2001. Asterisks indicate incomplete data.

<u>Year</u>	<u>% Catch Rainbow Trout with Dorsal Fin Erosion</u>	<u>% of Sample Tet- Mark Positive</u>
1996	5.2% *	2.9%
1997	13.8%	2.7%
1998	22.4%	no data
1999	3.9% *	2.9%
2000	16.0%	6.3%
2001	22.5%	0.0%

### Cliff and Wade Lakes

Over the years, monitoring of fish populations in Cliff and Wade lakes has been limited to gill netting or night electrofishing. Gill netting has been a marginal index of population trends, limited by net selectivity. On Cliff Lake, parasite loads have limited growth and potentially limited trout abundance. Gill netting catches have varied considerably on Cliff Lake, reaching a low point in 1994 (Table 17). Since then, rainbow trout catches have been relatively consistent, with a high catch in 2000. Average length of rainbow trout in gill nets indicates selectivity of nets against trout less than 6.0 inches long. Maximum size of rainbow trout in gill net catches has ranged from approximately 17 to 18 inches in 1991 and 1993, to a low of 11.7 inches in 1998. Since 1998, maximum length of rainbow trout caught in gill nets ranged from 14.6 to 15.2 inches. The impact of parasite loads has not been adequately analyzed, but is likely the prime factor limiting growth and survival. Bonneville cutthroat trout, introduced in 1990, have not been captured in gill nets, although anecdotal reports from anglers may indicate their continued presence. Similarly, brown trout were documented to be illegally introduced into Cliff Lake around 1992 (FWP Files), but none has been captured since.

Since the completion of the Wade Lake spawning channel in 1991, no trout have been stocked (Brooks 1992, FWP Files). However, rainbow and brown trout gill net catches have been very consistent since then (Table 18). Rainbow trout gill net catches have ranged from 3.0 to 6.0 between 1993 and 2001. Only one sinking net is traditionally set on Wade Lake, so brown trout catches are consistently low. However, several nets partially sank in 2001, which may have resulted in increased catch of brown trout. Because of additional sinking nets, white sucker catches increased dramatically in 2001. In general, trout populations in Wade Lake appear to be stable, with little variation in average size.

Table 17. Summary of catch rates and average length of rainbow trout caught in gill nets in Cliff Lake, 1991 – 2001.

YEAR	Number	Number per net	Mean length
1991	46	7.7	12.4
1993	21	4.2	15.5
1994	9	1.8	12.3
1998	31	6.2	8.9
1999	26	5.2	10.9
2000	49	9.8	9.4
2001	25	6.3	10.2

Table 18. Summary of gill net catches on Wade Lake, 1993 – 2001.

Year	rainbow trout per net	Average length of rainbow trout (inches)	Brown trout per net	White sucker per net
1993	6.0	16.5	0.2	5.0
1994	3.8	12.4	0.6	11.4
1998	4.2	14.9	0.4	16.0
1999	5.0	16.6	0.2	6.4
2001	3.0	14.5	0.8	30.2

#### Hyalite Reservoir

Spawner counts in the West Fork Hyalite Creek indicate Yellowstone cutthroat trout and Arctic grayling may be recovering from the loss of spawning habitat due to raising reservoir levels (Byorth and Weiss 2001). In 2001, a total of 2643 Yellowstone cutthroat trout were observed in the West Fork, a record high (Table 19). Arctic grayling spawner surveys have been conducted over a longer period than Yellowstone cutthroat trout, but a similar trend is apparent. After raising the reservoir level inundated critical spawning habitat, the number of adult Arctic grayling spawners diminished (Byorth and Weiss 2001). Since 1998, the numbers of adult Arctic grayling observed has stabilized near 20 per survey (Table 20). While considerably lower than the average between 1986 and 1994 (70 per survey), it is a more sustainable level than lows after dam-raising.

Table 19. Numbers of Yellowstone cutthroat trout (YCT) observed during spawner counts in the West Fork Hyalite Creek, 1995 – 2001, \* indicates years of incomplete surveys. Updated from Byorth and Weiss 2001.

Year	Number of Surveys	Number YCT Observed	Number YCT Per Survey	Peak Spawning Date
1995	6	259	43.2*	June 12*
1996	4	13	4.3*	*
1997	8	364	45.5	June 23
1998	16	1891	118	May 28
1999	11	1704	155	June 11
2000	9	1640	182	June 2
2001	8	2643	330.4	June 6

Table 20. Numbers of Arctic grayling observed during spawner counts in the West Fork Hyalite Creek, 1986, 1989 – 2001, \* indicates years of incomplete surveys. Updated from Byorth and Weiss 2001.

Year	Number of Surveys	Number Grayling Observed	Number Grayling Per Survey	Peak Spawning Date
1986	1	152	152	June 16
1989	*	85	*	*
1990	3	180	60	June 26
1991	1	50	50	June 26
1992	2	154	77	June 10
1993	16	555	34	June 21
1994	20	945	47	June 6
1995	7	45	6.4*	June 29*
1996	4	0	0*	*
1997	8	5	0.6	June 23
1998	16	453	28.5	June 22
1999	11	203	18.5	June 24
2000	9	130	14.4	June 13 – 19
2001	8	175	22	June 19

#### Camp Creek

We electrofished a 500 ft section of Camp Creek above the highway 84 culvert. We captured a total of 75 brook trout ranging in length from 4.3 to 8.4 inches. The two-pass population estimate was 82 per 500 ft ( $\pm 9.96$  95% CI). In the plunge pool below the culvert, we captured 19 brook trout ranging in length from 4.1 to 7.1 inches in 20 minutes of effort. The presence of brook trout in like numbers and size ranges, above and below the culvert, suggests that the culvert is not a barrier, or was not a barrier in recent times. The plunge pool below the culvert was approximately 36 inches deep, and the fall between culvert outlet and water surface was approximately 18 inches.



### Nash Spring Creek

We electrofished two 500 ft sections in Nash Spring Creek: the City Park section in the relocated (formerly channelized) reach, and the Sourdough Trail section 0.25 miles downstream in the unimpacted reach in March 2001. While sections were less than 0.25 miles apart, numbers of trout captured varied considerably (Table 21). In the City Park Section rainbow trout predominated, followed by brook trout and brown trout, respectively. However, in the Sourdough Trail Section, the unimpacted reach, brown trout were 84% of estimated trout abundance. Only 10 rainbow trout and 3 brook trout were captured. Mottled sculpin were much more abundant in the unimpacted reach (53 captured) than in the unimpacted reach (17 captured). In the City Park Section, the largest rainbow trout captured was 13.3 inches long; however, over half the rainbow trout captured was under 3.0 inches long and only 4 were over 7 inches. In the Sourdough Trail section, rainbow trout ranged from 2.7 to 11.7 inches long. Brown trout ranged as high as 13.9 inches long, with over half under 6.0 inches long. In the City Park section, browns were 2.0 to 9.8 inches long. Brook trout were larger and more abundant in the City Park Section ranging from 3.3 to 10.0 inches long and 58% over 6.0 inches long. In the Sourdough Trail reach, only 3 brook trout were captured, all from 3.1 to 3.6 inches long.

Apparently, the newly relocated reach provided a greater diversity of habitat to support all three species in higher numbers. However, the unimpacted reach may represent a more stable "climax" fish community where brown trout may out-compete the other species. We will continue to monitor the response of trout populations to the stream relocation.

Table 21. Estimated abundance of trout in Nash Springs Creek in two 500 ft sections. Low sample sizes are reported as number captured. Point estimates and 95% confidence bands are reported if sample sizes were adequate.

Section	Brown Trout	Rainbow Trout	Brook Trout
City Park	25 (24 to 27)	50 (44 to 06)	39 (38 to 44)
Sourdough Trail	78 (75 to 84)	10	3

### East Catron Creek

East Catron Creek runs through farmland that has undergone a rapid conversion to retail development since 1996. Approximately 1 mile of stream has either been relocated or will be relocated by the end of 2002 to accommodate development. Because the stream was channelized for agriculture in the 1950's, development offers the opportunity to restore the stream to more natural condition and improve fish habitat. To track changes in fish community structure during and after relocation, we electrofished several reaches of East Catron Creek.

The Wingate Section was relocated circa 1996. We electrofished 500 feet of relocated channel between Catron Street and a pipeline crossing. In 1999, we captured 107 fish of 6 different species (Table 22). Mountain whitefish comprised over half of the total, ranging in size from 5.7 to 7.0 inches long. In April 2001, we did not capture any mountain whitefish. We captured 34 brown trout in 1999, but only five in 2001. Brown trout ranged from 4.9 to 13.7 inches long in 1999 and 3.7 to 10.4 inches long in 2001. Brook trout were captured in both Wingate and Catron sections in 1999, but were found only in the Golden Willow Section in 2001. Rainbow trout up to 6.0 inches long were captured in 1999, but ranged from 4.9 to 10.0 inches long in 2001. Numbers of all other species declined in the Wingate section, except for white sucker, which increased markedly.

Similar results were found in the Catron Street section, relocated in 2000. Abundance of all trout species decreased after relocation. Brown trout up to 13.8 inches were captured in 1999, but ranged in length from 4.7 to 6.2 inches in 2001. Longnose dace and white sucker increased in the Catron Section. The Valley Center and Golden Willow sections are scheduled for relocation Summer 2002. Neither reach supported significantly different numbers of fish than the others in 2001, but a fathead minnow was captured. The Golden Willow Section supported more brown trout than the others did in 2001, from 4.5 to 6.4 inches long.

Thus far, it is difficult to attribute changes in fish abundance solely to stream relocation. Severe drought has affected groundwater levels and consequent stream flows since 1999. In addition, extensive development upstream of the relocated reach may have effected water quality and quantity. In general, numbers of fish did not allow us to calculate population estimates and catch-per-effort may be biased by electrofishing conditions. We will continue to monitor these sections to track the affects of stream relocations and intended habitat improvement.

### Conclusion

Trout populations are subject to a wide variety of environmental factors that regulate their abundances from year to year (Platts and Nelson 1988). In the Madison and Gallatin drainages, flow regimes, drought, predation (human and otherwise), and habitat condition all regulate trout populations to some extent. In general, trout populations are stable in the Gallatin drainage, mostly at or near recorded high levels. However, persistent drought is likely to affect trout populations in the next several years. In the Madison River, brown trout populations are above long-term averages in most sections. Rainbow trout, however, are subject to the effects of whirling disease, and likely to decrease from current levels due to recruitment limitation. Catch-per-effort trends in lakes and reservoirs are varied, with very strong stable populations in Wade Lake, average levels in Hebgen Lake, improving levels in Hyalite reservoir, and average levels in Cliff Lake still hampered by parasite loads. Impacts of development on urban streams in the Gallatin Valley are under investigation. In the future, we hope to have more conclusive data on the response of trout populations to stream relocation and enhancement.

This document reports monitoring activities in the Madison and Gallatin drainages during 2001. Summary data are provided to illustrate trends in fish populations or to address specific management concerns. Conclusions beyond the scope of basic trends are speculative and they would require more in-depth analysis.

Table 22. Summary of numbers of fish caught per electrofishing surveys in East Catron Creek April 1999 and April 2001.

Species	Valley Center April 2001	Wingate (relocated 1996)		Catron Street (relocated 2000)		Golden Willow April 2001
		April 1999	April 2001	April 1999	April 2001	
Brown Trout	4	24	5	19	7	8
Brook Trout	0	3	0	4	0	2
Rainbow Trout	4	6	2	4	1	1
Mountain Whitefish	0	54	0	0	0	0
Longnose Dace	4	0	7	1	8	10
White Sucker	4	10	43	3	13	3
Longnose Sucker	0	0	4	0	0	1
Mottled Sculpin	3	10	4	10	8	6
Fathead Minnow	1	0	0	0	0	0

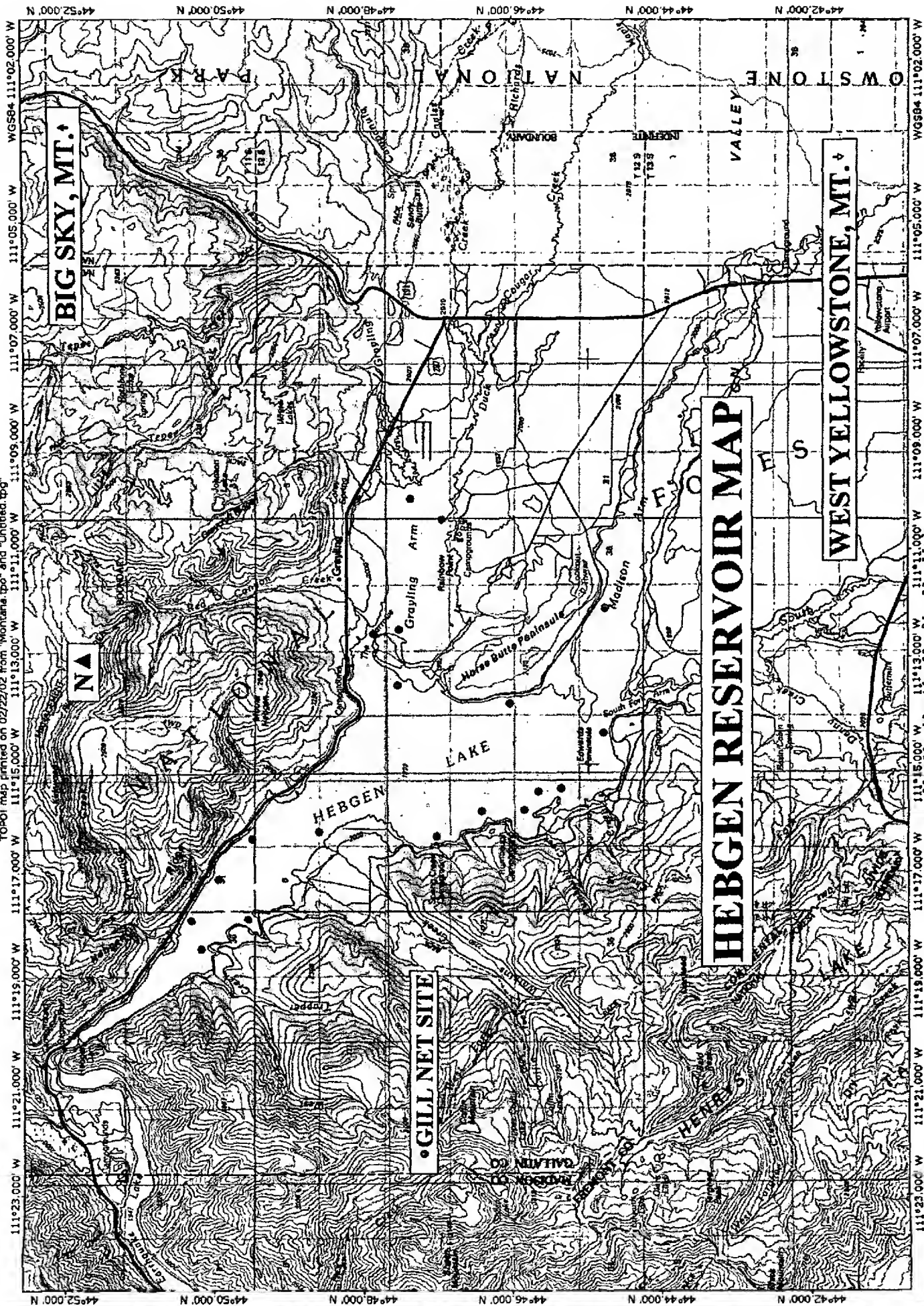
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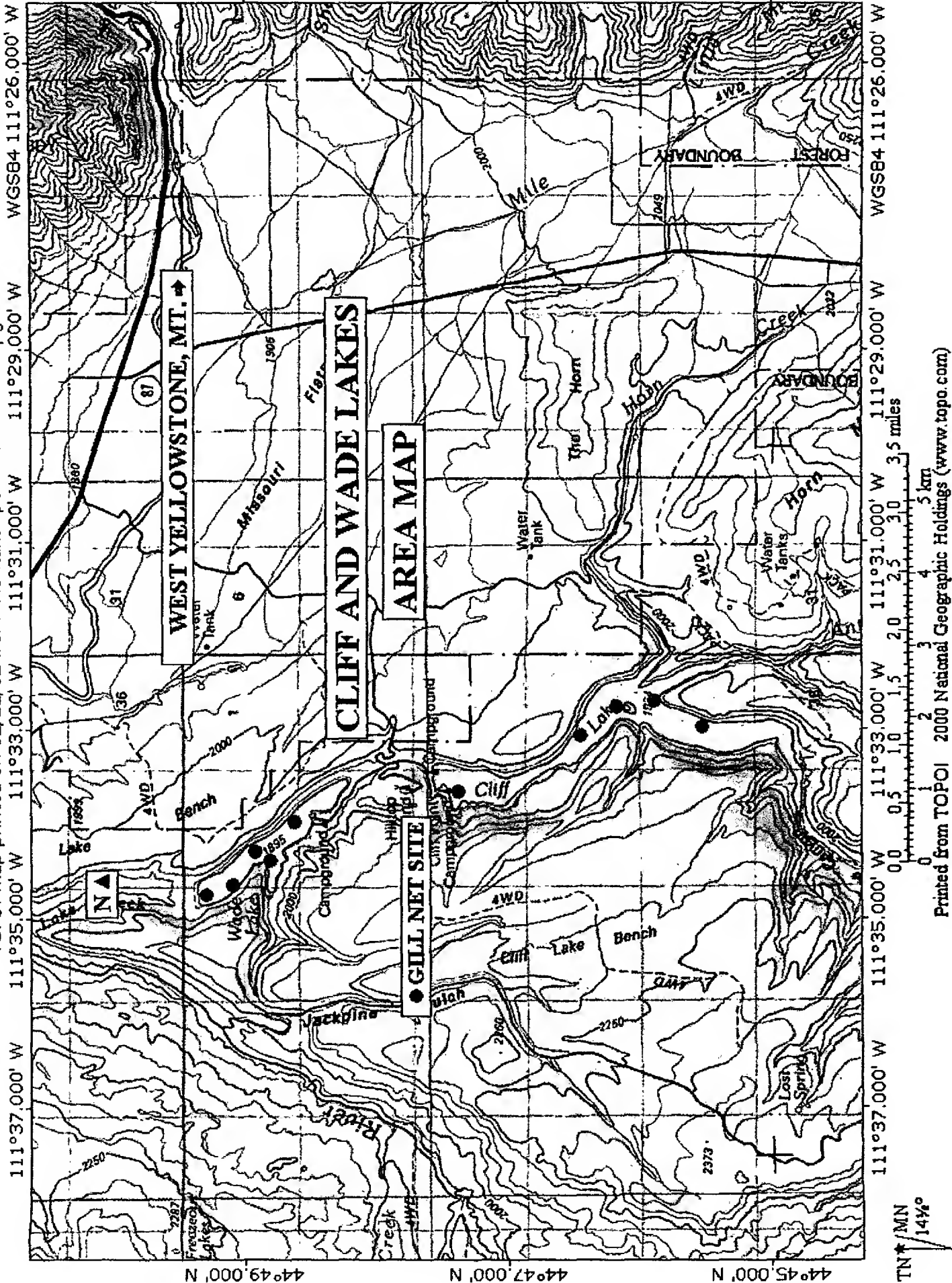
**Appendix A. Maps of streams, lakes, and reservoirs displaying study sections.**

Topo! map printed on 02/22/02 from "Montana topo" and "Untitled topo"

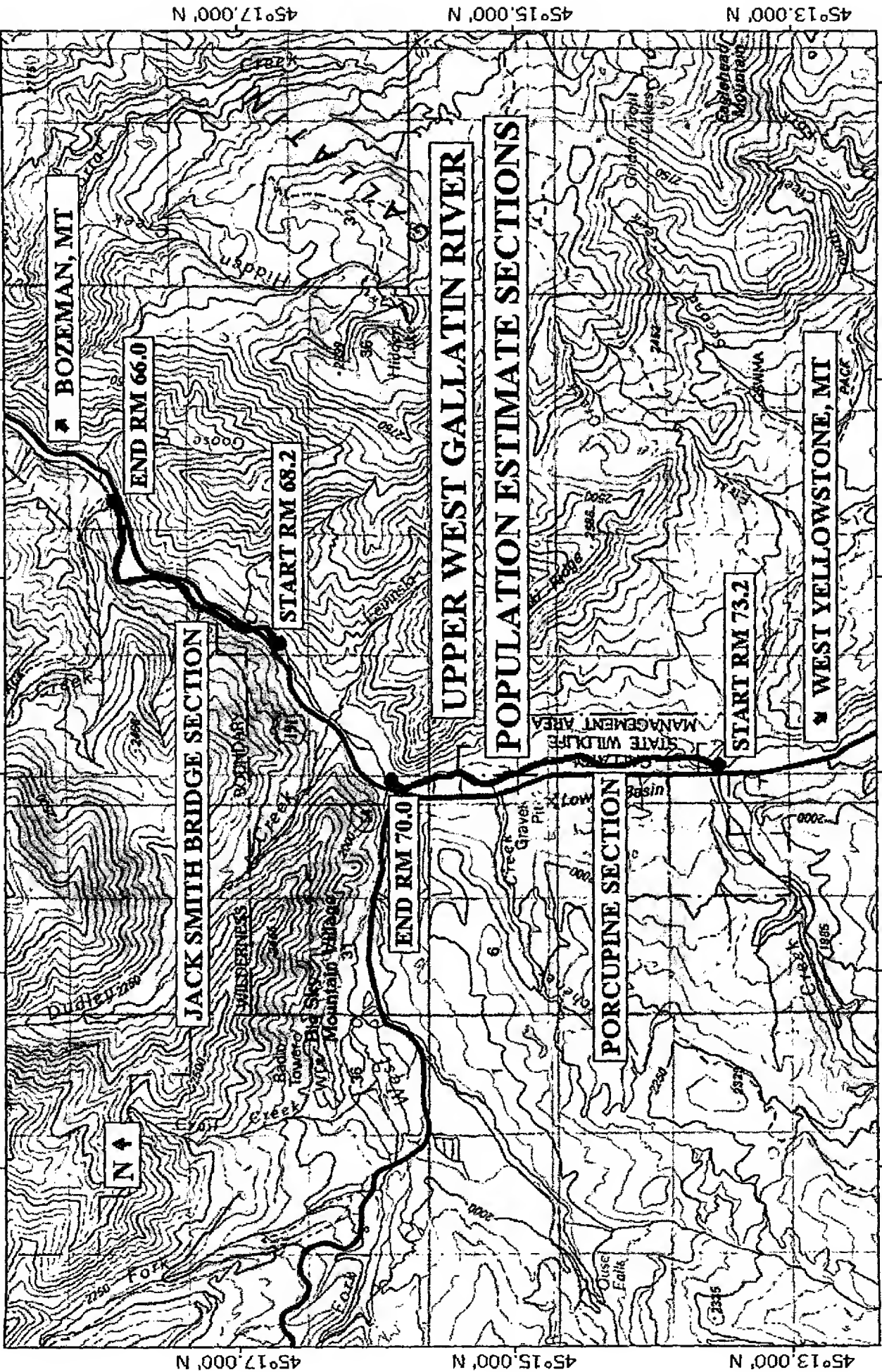


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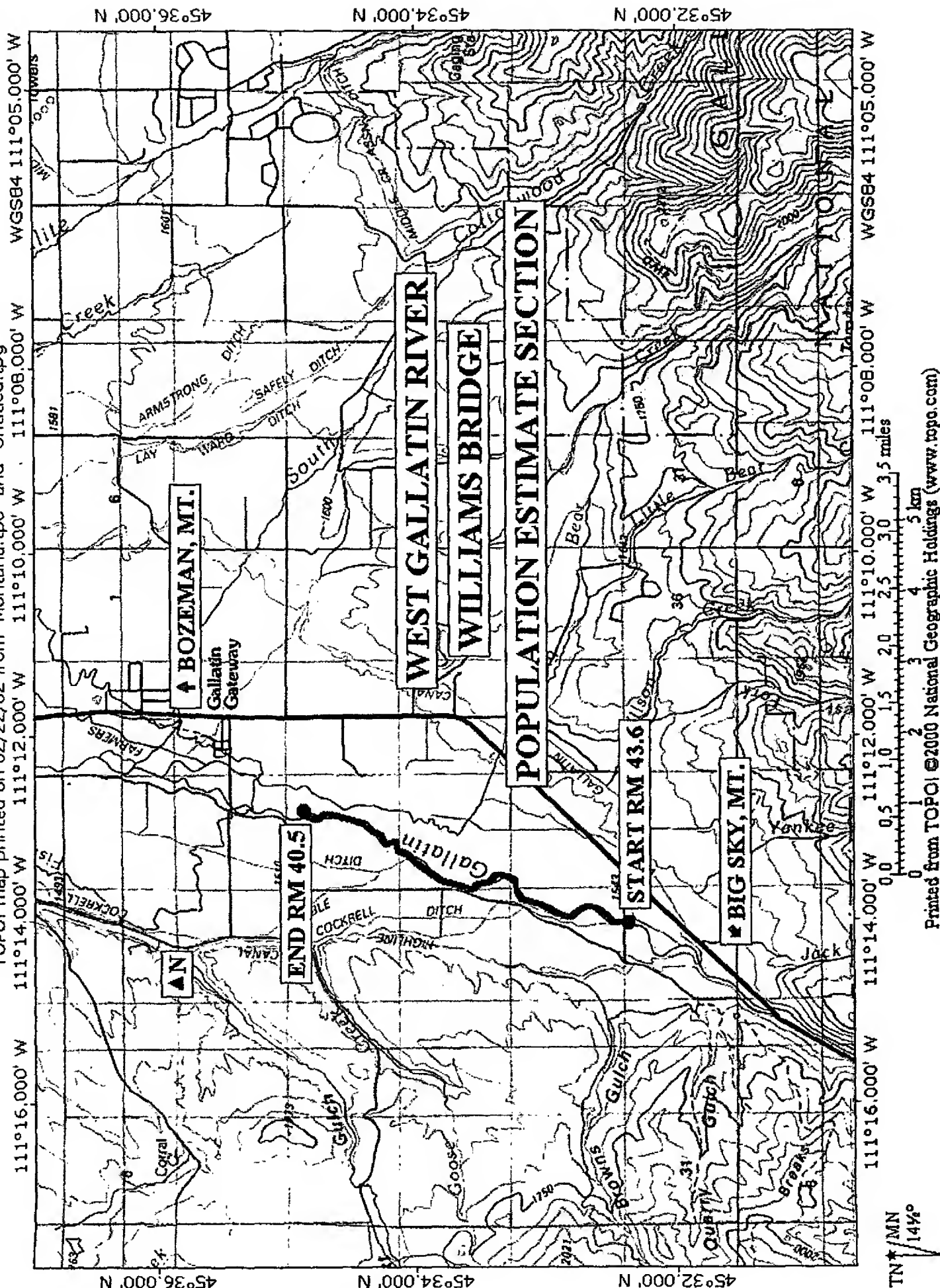
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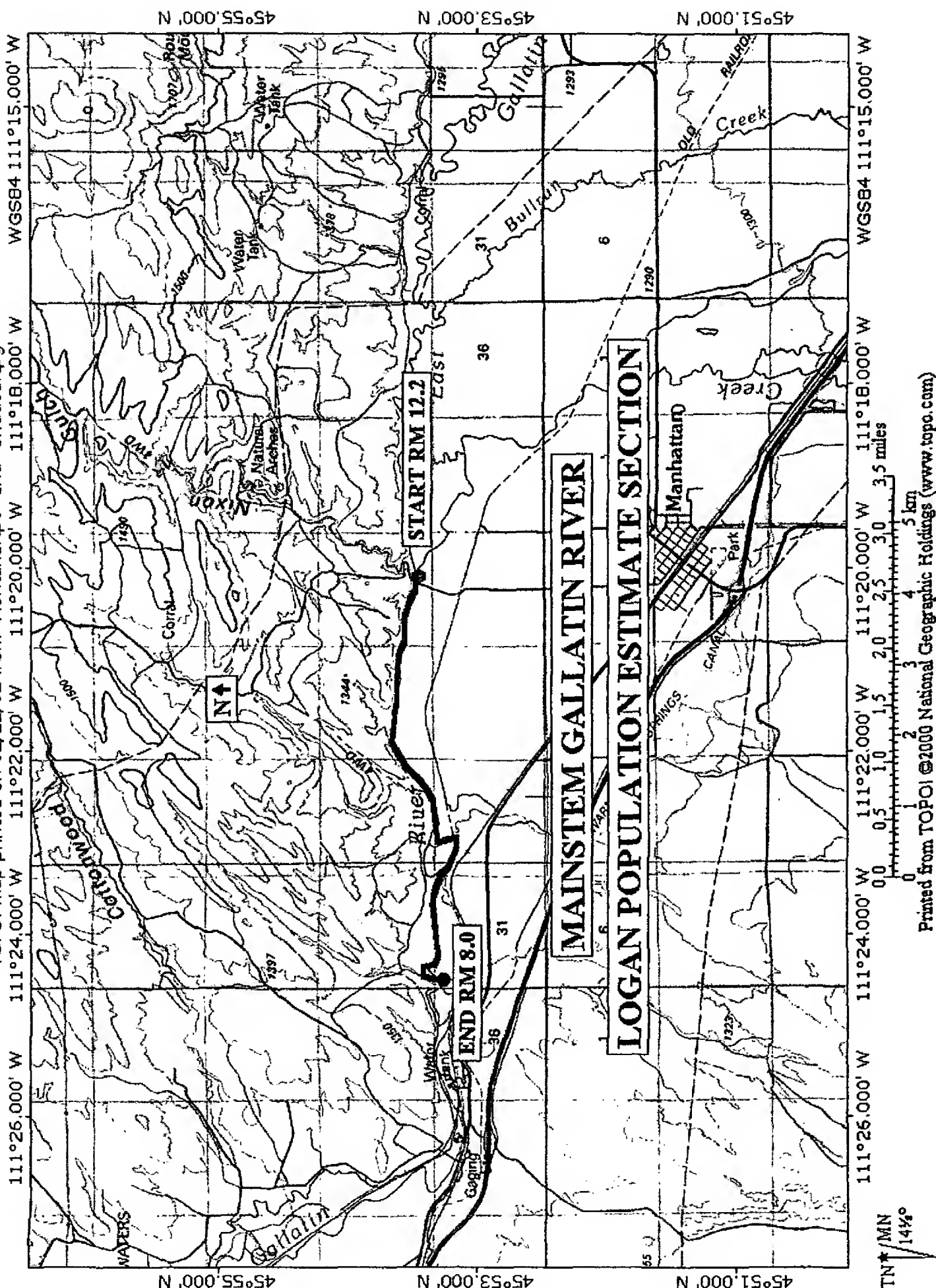




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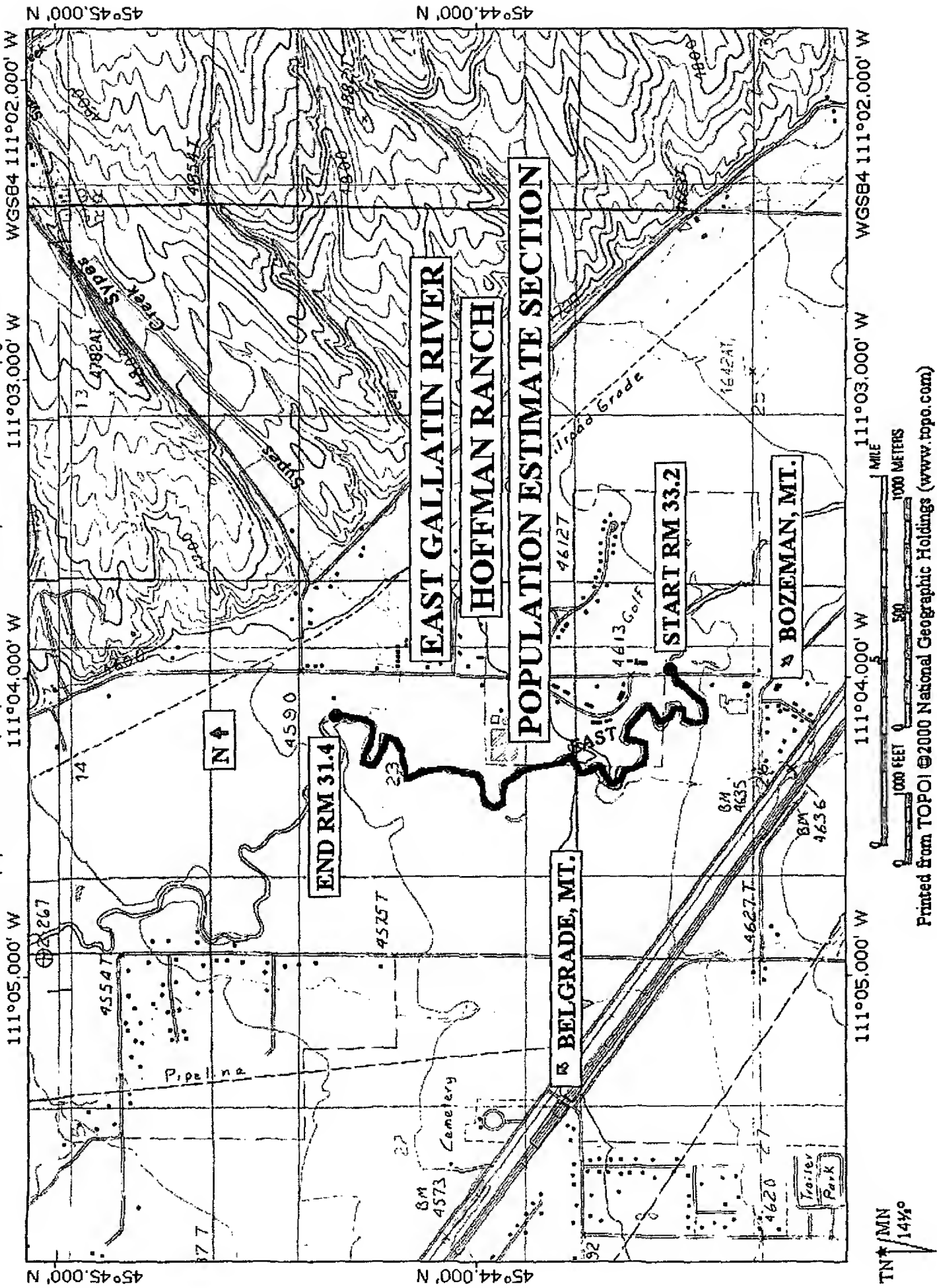
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TN/MN  
14%

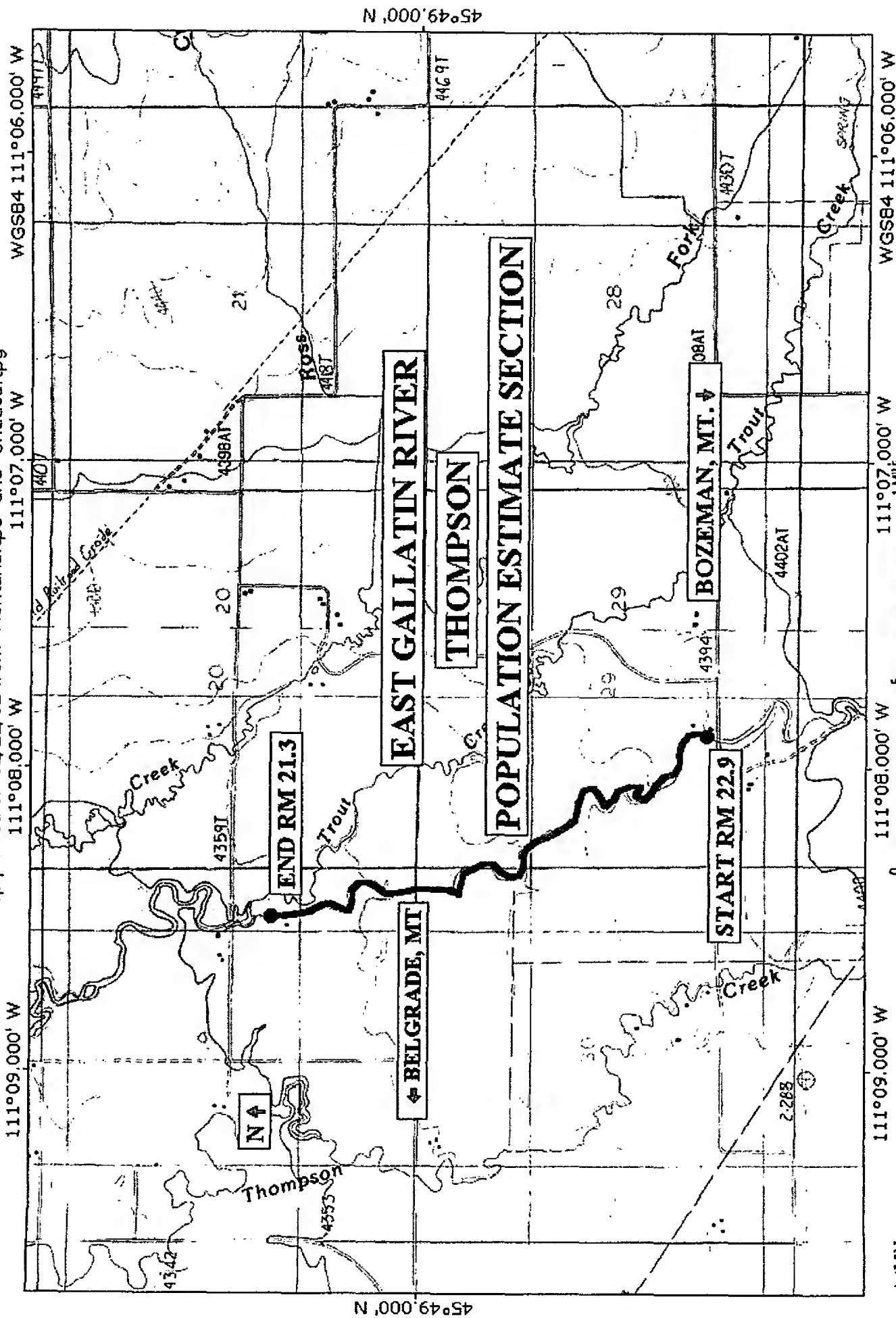
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TOPOI map printed on 02/22/02 from "Montana.tpo" and "Untitled.tpg"



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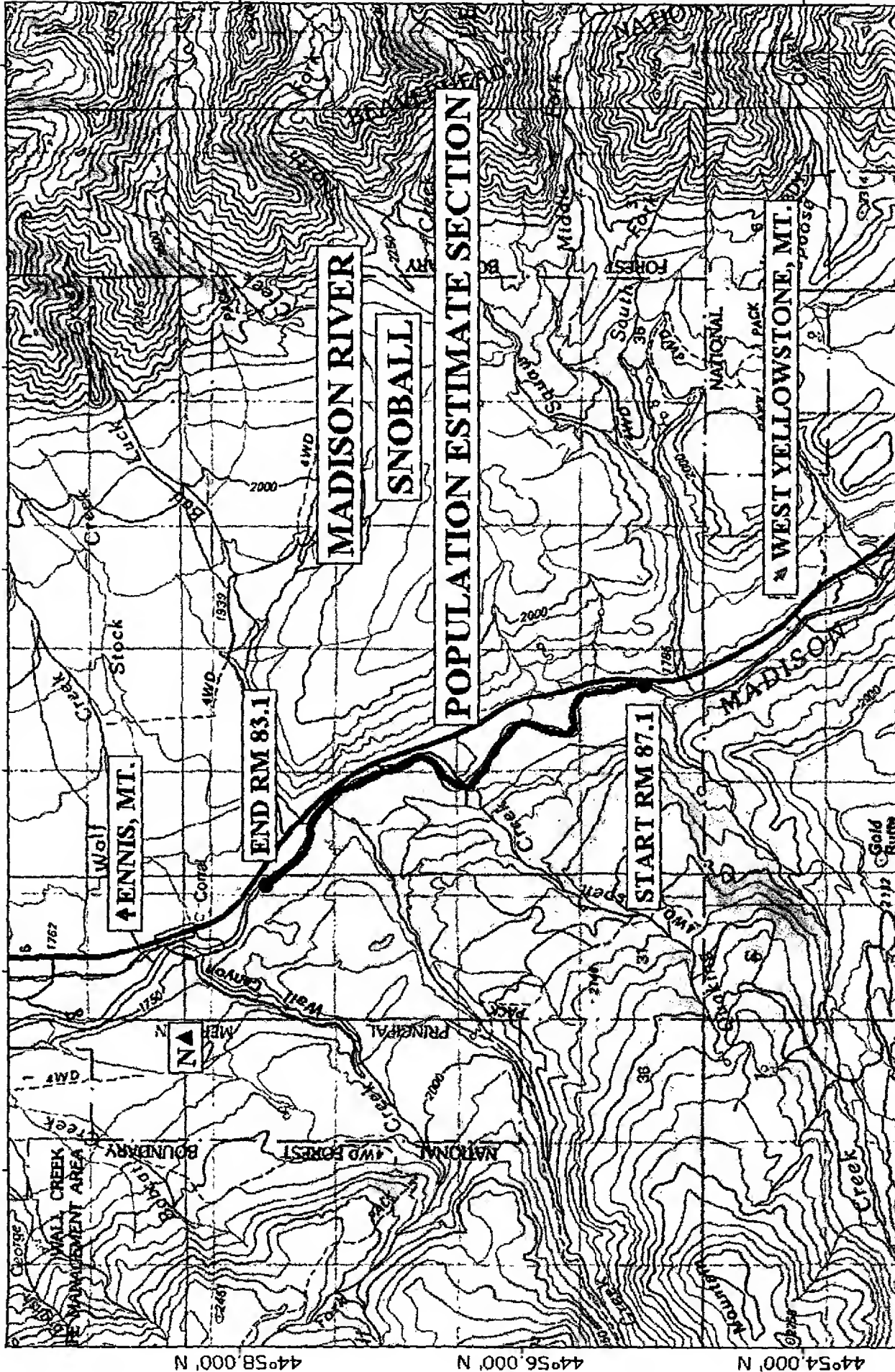


TN/MN  
144°

44°50.000' N 44°52.000' N 44°54.000' N

THE

111°41.000' W	111°39.000' W	111°37.000' W	111°35.000' W	111°33.000' W	111°30.000' W
WGS84	WGS84	WGS84	WGS84	WGS84	WGS84



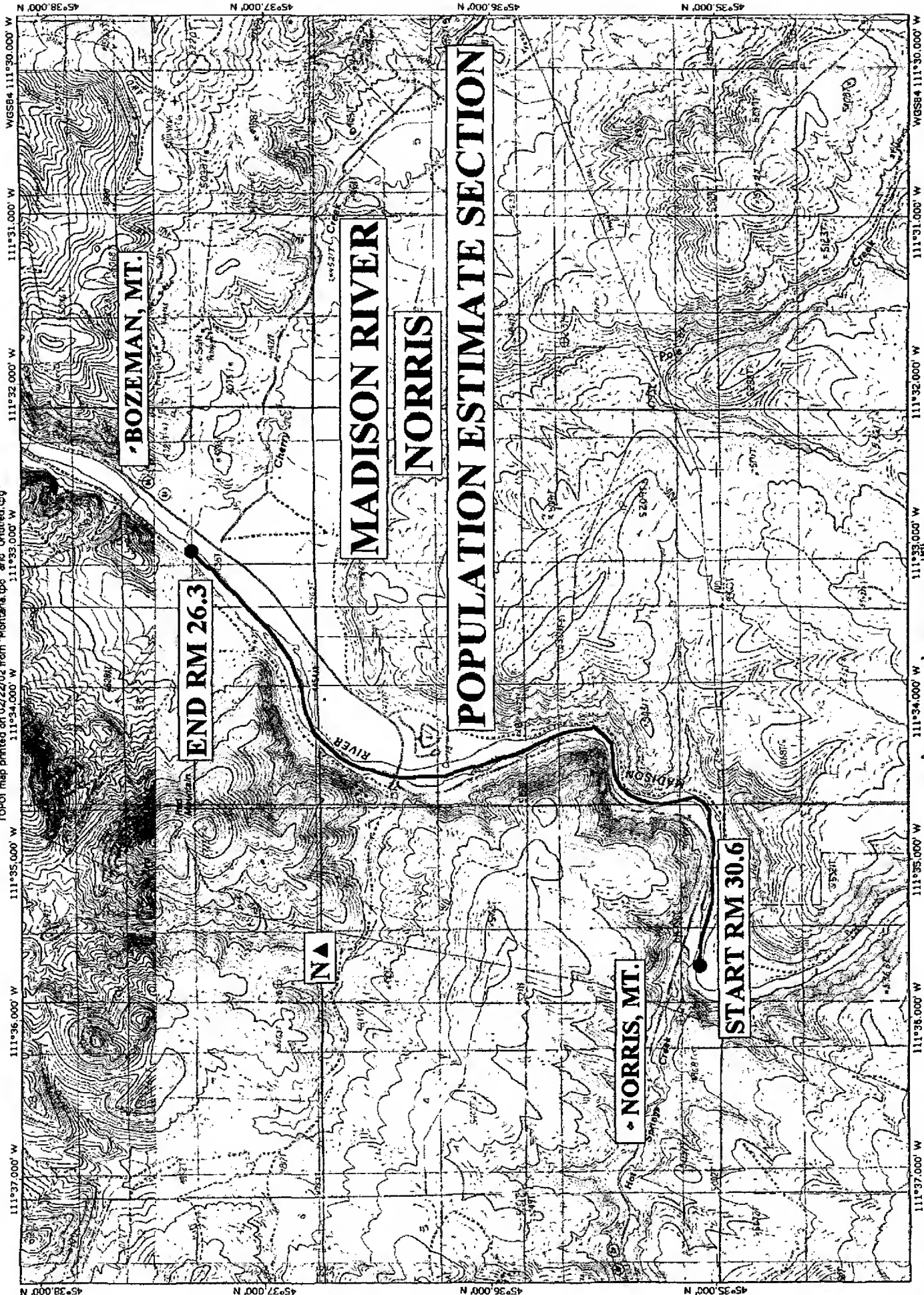
111°41.000' W	111°39.000' W	111°37.000' W	111°35.000' W	111°33.000' W	WGS84 111°30.000' W
	00	05	10	15	20
					25
					30
					35 miles

TN\* MN  
14 1/2°

0 1 2 3 4 5 km  
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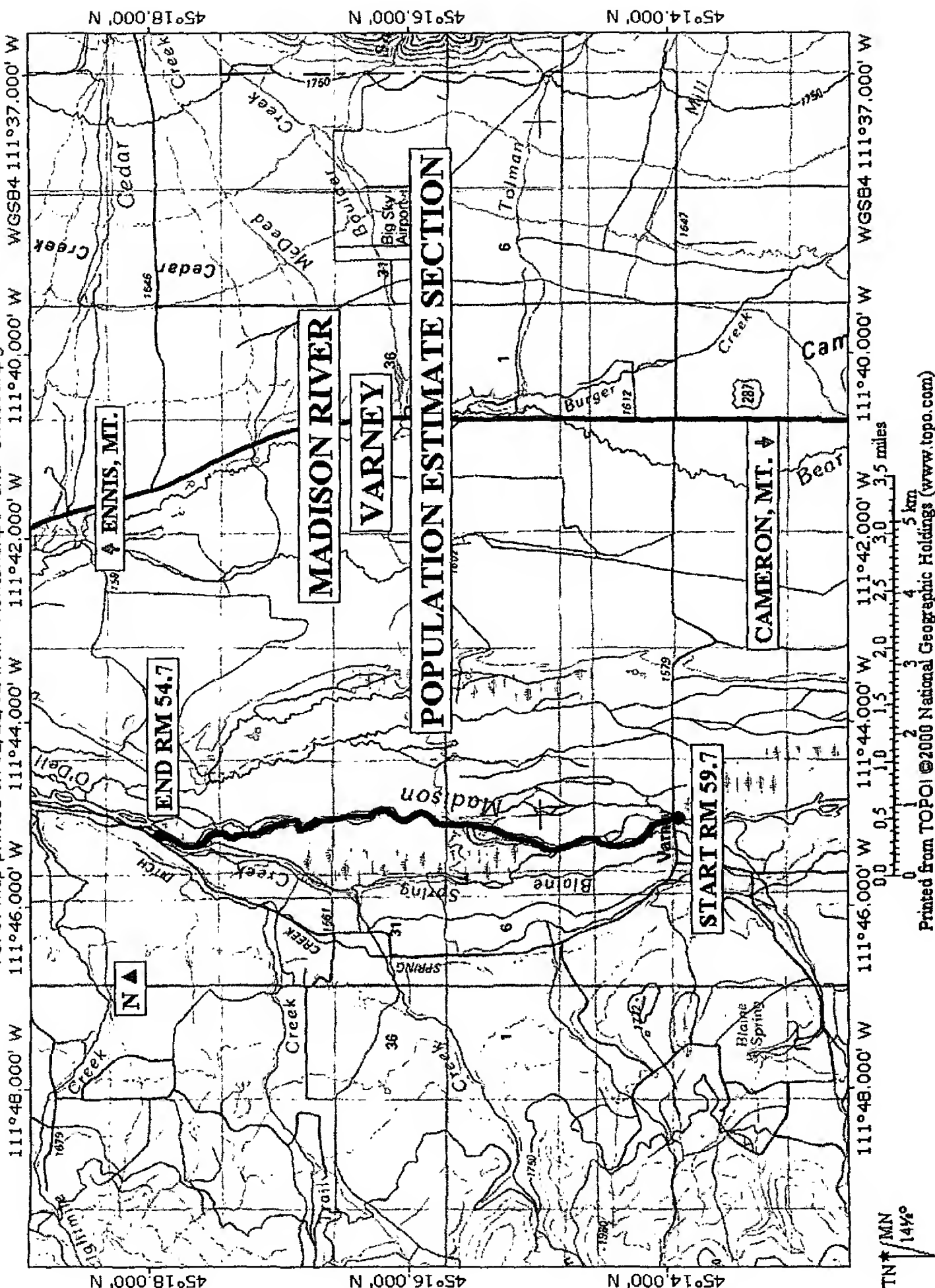
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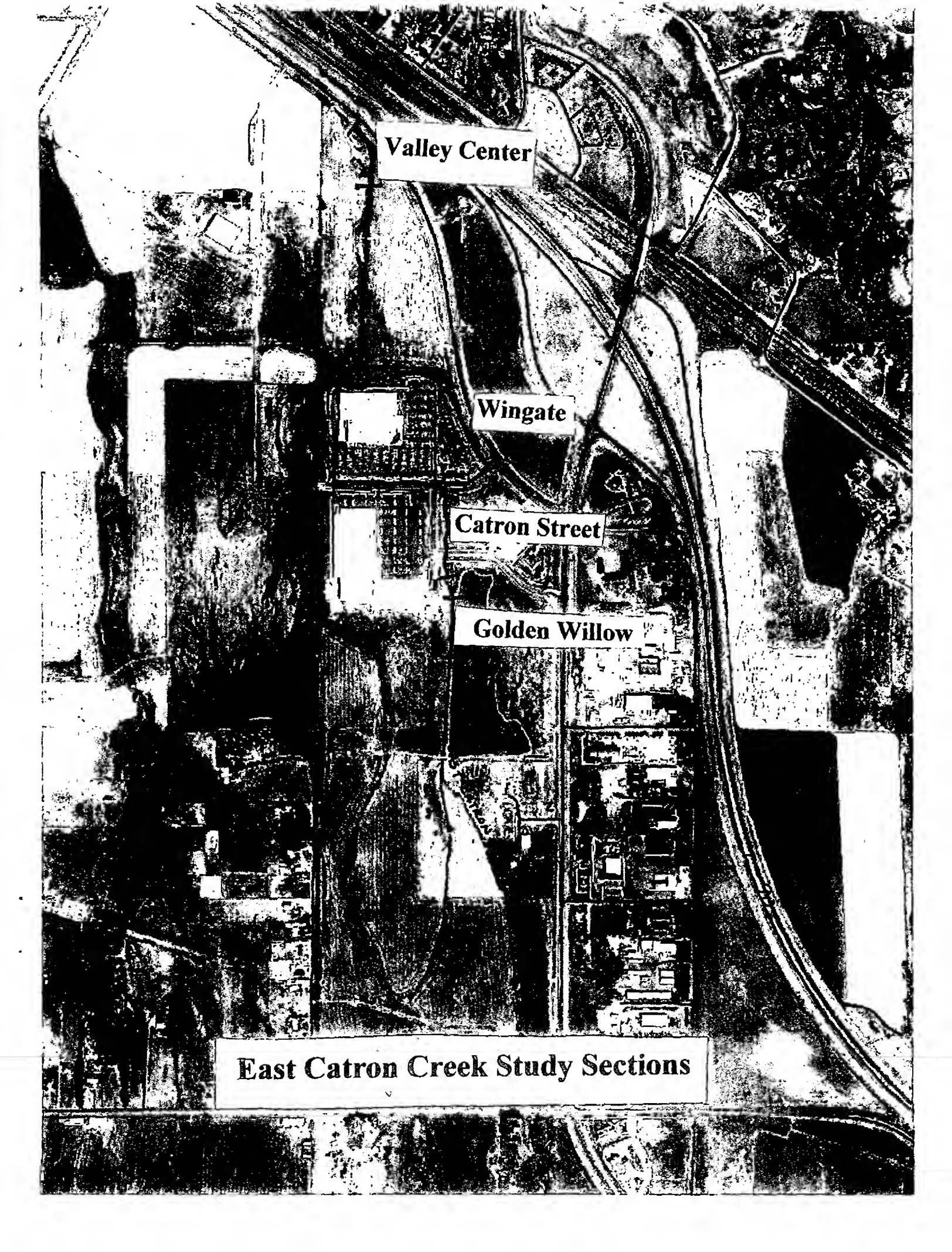


TN 9 MN  
145°

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Valley Center

Wingate

Catron Street

Golden Willow

East Catron Creek Study Sections